MPAs & FISHERIES IN SOUTHEAST ASIA

MODULE 9

9.1 FUNDAMENTALS OF FISHERIES MANAGEMENT

Goals of Fisheries Management

Fish Catch & Fishing Effort

Overfishing and the Tragedy of the Commons

Tropical Fish Ecology

Fishing Methods & Gears

9.2 FISHERIES MANAGEMENT STRATEGIES FOR SE ASIA

Practical Strategies & Tools

Management Considerations for Different Habitats

Review: Zonal Management

Assessment

9.3 RESPONSIBLE MARICULTURE PRACTICES

Common Mariculture Practices

Problems of Mariculture

9.4 FIELD TRIP: LOBSTER & FINFISH MARICULTURE

Acknowledgements

The majority of information presented in this module is drawn from the following publications:

Department of Environment and Natural Resources, Bureau of Fisheries and Aquatic Resources of the Department of Agriculture, and Department of the Interior and Local Government. 2001. *Philippine Coastal Management Guidebook No. 6 Managing Municipal Fisheries.* Coastal Resource Management Project of the Department of Environment and Natural Resources, Cebu City, Philippines. **(PH-6, 2001)**
www.oneocean.org.

IUCN 2004. *Managing Marine Protected Areas: A TOOLKIT for the Western Indian Ocean*, IUCN Eastern African Regional Programme, Nairobi, Kenya. 172pp.
www.wiomsa.org.

OVERVIEW

To make effective management decisions, MPA managers need to know the basics of fisheries management - how fish stocks respond to fishing effort, and the specific effects and particular fishing techniques used in the local area.

Since fishes are a common resource generally available to all, fisheries are particularly susceptible to the "Tragedy of the Commons" - the overexploitation of a common resource. Any fish stock can only sustain a given level of fishing pressure before catch will start to decline due to overfishing. Throughout Southeast Asia, most fish stocks are currently overfished. This means that most non-commercial fishers can only catch relatively small numbers of poor-quality fish, despite increased fishing effort with intensive fishing methods and gear. This situation can trap fishers and sometimes entire communities in poverty and hunger.

If fishing effort can be reduced, fish stocks can and will recover from overfishing, often in just a few years in tropical areas. Methods of reducing overfishing include restrictions on fishing methods or gear, zoning, licensing, and more. But for these efforts to be successful, they must have the support of local fisher people. In particular, local fisher people must have other ways of earning income while the fish stocks are recovering.

Module 7 is designed to help you review your current understanding of, and acquire additional knowledge of, the ecological and biological factors that affect fish population size, fish catch, and the impacts of different fishing methods and aquaculture methods on fish stocks.

IMPORTANCE OF FISHERIES MANAGEMENT SKILLS

To make effective management decisions, and to advise local communities in ways that will strengthen fish stocks and benefit fisher people and the local environment, a MPA manager needs to understand the relationship of fish stocks to fishing pressure, to the local environment, and the impacts of fishing methods, gear and aquaculture.

LEARNING OBJECTIVES

- ✓ Understand and review the factors that affect fish population size and fish catch.
- ✓ Learn why fish stocks are particularly vulnerable to overfishing.
- ✓ Consider the impacts of different fishing methods, gear, and aquaculture on fish stocks; and share your knowledge of how these methods are practiced in your area.

LINKS TO OTHER EFFECTIVE MANAGEMENT AREAS

Zonal Management

Some of the most effective methods of fisheries management are based on dividing the marine ecosystem into zones for different uses. MPAs, of course, are one type of zone. This topic is covered more fully in the Zonal Management section.

Community-based Management

All fisheries management decisions need to involve the local community. Restriction of fishing methods and gear, zoning, and other management methods will only be successful if local fisher people understand and believe in the methods. Involvement of the local community is particularly important during the recovery period when fishing effort may be dramatically reduced or when a new zone has just been put into place. In Southeast Asia, most fisher people face the constant pressures of poverty and hunger, which make it necessary for the MPA manager to consider alternative livelihood strategies for displaced or compromised fisher people.

Management Planning

MPA managers must understand the basic concepts of fish populations, fishing methods and gears, and aquaculture. But understanding is not enough to cause changes. Translating the concepts into creative, effective actions requires management planning and careful examination of alternatives.

Enforcement

All fisheries management involves regulations - zones, licenses, restrictions on fishing gear, etc. But regulations will only be effective if fisher people actually comply with the regulations. Education for the reasons for regulations as well as on-the-water enforcement skills are necessary to ensure that regulations actually are followed.

Sustainable Tourism

Tourism can be an excellent alternative source of income for the local fisher population, either temporarily (while overfished stocks are recovering) or permanently. But tourism itself can cause its own impacts, so should be carefully evaluated before implemented as an alternative livelihood.

Communications

Good fisheries management cannot occur without the support of the local people (especially the fisher people), and requires the support of local government, regional government and sometimes neighboring states and countries. MPA managers who are comfortable working with the media will be better able to explain their actions and goals to local, national, and international audiences, and be better able to gain their support.

INDICATORS OF EFFECTIVE FISHERIES MANAGEMENT KNOWLEDGE

A MPA manager should have a good working knowledge of the general relationship of fish stock size to fishing effort, and the general causes of overfishing. In addition, a MPA manager must have working knowledge of specific fishing gear, fishing methods, and mariculture methods that are commonly used in his or her local area, and should also know *why* the local people have chosen to use those methods rather than others. A MPA manager should know which of these fishing methods and gears are particularly aggressive in reducing fish stocks; destructive to the seafloor, reef, or other habitats; and understand how these methods could best be regulated to ensure healthy fish stocks, sufficient income for fisher people, and a healthy environment.

Assessing what you have learned about Fisheries Issues in Southeast Asia

At the end of this two-week Management Capacity Training Program, you will talk with your team members about the different habitats that are in your area and how they are related, the fishing and aquaculture methods in your area, and the fish stocks in your area which might be overfished.

Long-term indicators of a good understanding of Fisheries Issues in Southeast Asia

A MPA manager who stays well-informed on fisheries issues will:

- ✓ Understand how removal of one fish stock or one habitat can affect other fish species and other habitats; be better prepared for possible ecosystem changes.
- ✓ Be aware of new fishing methods or gear used by local people; recognize, and take steps to reduce use of particularly destructive methods & gear.
- ✓ Be aware of new local aquaculture and how it affects the surrounding environment.
- ✓ Continually monitor the local fisheries for signs of overfishing. (This may require gathering regular information on catch size, size of individual fishes, and fishing effort.)

LESSON PLAN

Discussion - Review & Discuss

First, have one person from each group discuss the implementation plan that the group developed for the Management Planning module (days 4-6).
Next, discuss the following questions with your group:

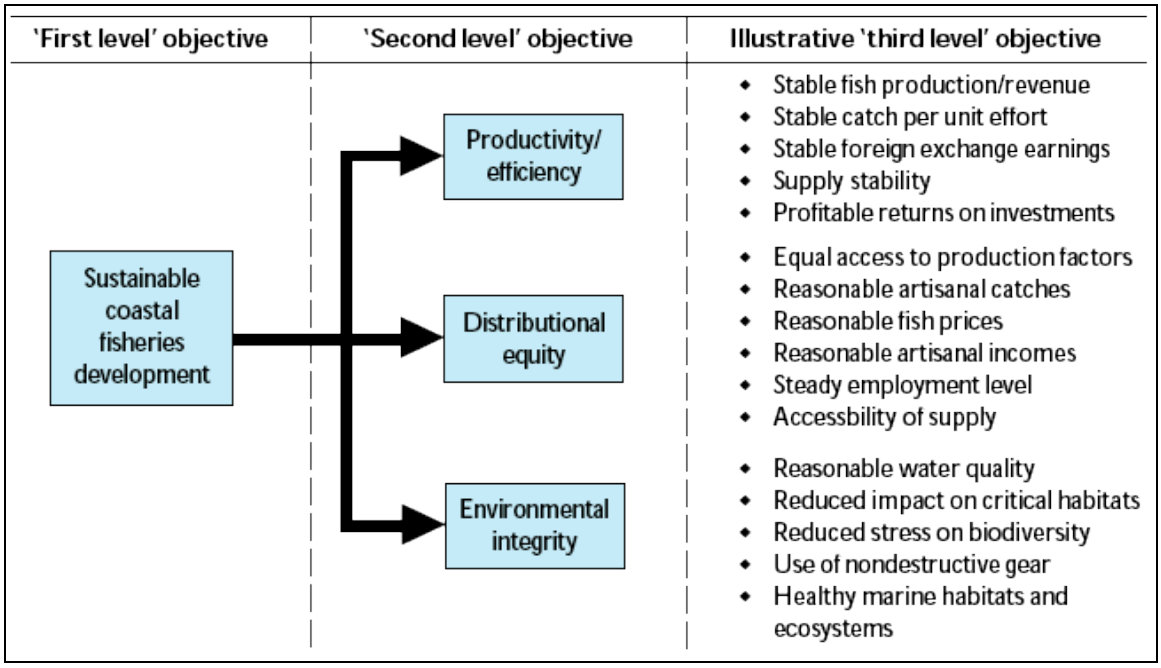
Think of all of the fishing & aquaculture methods that people currently use in your area.

- *Which are the most commonly used methods? Why?*
- *Which fish stocks in your area do you think are most overfished? The least?*
- *What information do you have that lets you assess which stocks might be overfished?*
- *What other information do you wish you had?*
- *Which fish stocks or fishing methods or habitats would you like to know more about?*

9.1 FUNDAMENTALS OF FISHERIES MANAGEMENT

Three Basic Goals of Fisheries Management

Fisheries management has three main goals: productivity (lots of fish), distributional equity (all fisher people can make a decent living), and environmental integrity.



(PH-6, 2001)

To accomplish these three goals, it is essential to first have a good basic understanding of the relationships of fish stocks, fishing effort, and fishing methods, and the interrelationships of different species and habitats.

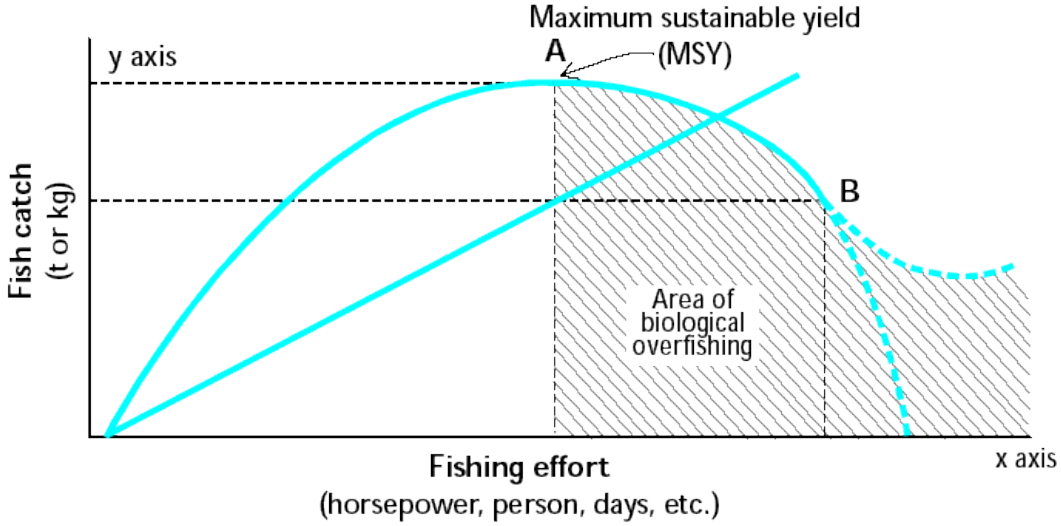
Fish Catch and Fishing Effort: Do More Boats Catch More Fish?

Handout 9.1: Definitions of Terms Used in Fisheries Management

Let's now turn to basic fisheries science: fish biology and ecology, what methods people use to fish, and why they choose those methods. First, let's review how fish stocks respond to being fished. The basics are simple: **mortality** (death) from fishing, or from other causes, reduces the size of a fish stock, but this can be balanced by **reproduction** and **recruitment** (settlement of young fish in a certain area; or, growth of young fish to a catchable size).

A fish stock can tolerate a certain level of mortality, if the mortality is balanced by reproduction and recruitment. At high levels of mortality, however, the stock cannot reproduce fast enough to replace the fish being killed, and the stock size will decline.

The amount of fish caught (fishery production or **catch**) changes with **fishing effort** like this:



(PH-6, 2001)

Fish catch is shown on the y-axis, measured in kg or tons. Fishing effort, on the x-axis, can be measured in many ways, such as number of boats, weight (tonnage) of boats, number of fisher people, time spent fishing, or distance traveled; or a combination of these measurements.

At low levels of fishing effort, an increase in fishing effort results in greater catch - i.e., if more boats go out to sea, more fish are caught. This will continue up to a certain point, the **maximum sustainable yield (MSY)**. Beyond this point, adding more boats or fisher people will cause in a *decrease* in total catch. This is because fish are being removed from the population faster than they can reproduce. This state is called **overfishing.** At point B on the curve, this process can accelerate so that a small increase in fishing effort causes a large decrease in catch. Many fisheries around the world are currently in this state, at point B or beyond.

In real life, the relationship between fish catch and fishing effort is not this predictable. Fish population size fluctuates with other factors such as diseases, predators, and the food base. Also, if recruitment and growth, the two factors that cause stock sizes to increase, are affected by environmental factors such as **pollution** or **habitat destruction**, stock size will decrease, and a given level of fishing effort will then have a greater impact. Sources of pollution include industrial runoff, agricultural and domestic wastes from land, and disposal of wastes by ships at sea. Habitat destruction on land, such as deforestation, can lead to increased siltation of the coastal zone. Underwater habitats can be directly damaged by destructive fishing practices.

Overfishing

Overfishing is the reduction of a fish catch to undesirable levels, due to too much fishing effort. It may be defined from two viewpoints, biological or economic:

Biological overfishing is, simply, a decrease in fish catch that is caused by too much fishing effort. Biological overfishing can take several forms, which often occur together:

- ***Growth overfishing*** occurs when fisher people catch too many small fish - young fish that have not yet had time to grow. The remaining fishes may be numerous, but they are very small (i.e., even smaller than the fish that are caught).
- ***Recruitment overfishing*** occurs when fisher people catch too many adult fish from the population, faster than the remaining fish can breed. The remaining fish may be large, but there are very few of them.
- ***Environmental overfishing*** occurs when almost all fish stocks decline at the same time. In a healthy environment, if one fish stock declines, another fish stock usually increases. But if the entire environment is being overfished, all fish stocks can decline at once, leaving no alternatives for fisher people.

All these forms of biological overfishing usually lead eventually to **economic overfishing**: a decline in the income of fisher people. Greater effort and more expensive gear are needed to catch ever-smaller numbers of poorer-quality fish. Ultimately, fishing becomes so difficult that

fisher people can no longer make a good living, and they are often driven into poverty and hunger.

Recovery from overfishing

Most fish stocks can recover from overfishing. If fishing effort is reduced, fish stocks will generally recover. *But recovery takes time*. Tropical fish stocks recover more rapidly from overfishing (once fishing effort is reduced), compared to cold-water fish stocks, but even in tropical areas it will usually take several years before a fish stock recovers enough to be fished once again.

In the long run, it is clearly to the benefit of the local fisher people to wait until the stock has recovered - ultimately, there will be more and bigger fish, and fishing will require less effort. However, local fisher people need to understand and be prepared for the several years of recovery time, and they will usually need *alternative sources of employment* before fishing will once again be a viable way for them to make a living.

Discussion — Overfishing in MPAs

Consider what you have learned about overfishing, and discuss the following questions with your group.

What fish stocks are being overfished in your MPA?
Which type(s) of overfishing do you think is occurring?
What is being done to address overfishing in your MPA?

The Tragedy of the Commons

History shows that if a fishery is not regulated, overfishing almost inevitably occurs. The fish stock and catches decline, despite increasing effort and more aggressive fishing methods. This pattern occurs in fisheries everywhere around the world. Interestingly, it does not occur as often on land. A rancher, for example, does not remove more animals from his herd than will be replaced by breeding. Yet fisher people often do this. *Why do fisher people make this error?*

Handout 9.2: The Tragedy of the Commons

Exercise 9.1: "Tragedy of the Commons" Game

As the "Tragedy of the Commons" game illustrates, if all people have unlimited access to a common resource, there is no incentive for any one person to conserve the resource. If one fisher tries not to fish too much, he (or she) will not benefit from his restraint, because others will simply catch those fish that he spared. This leads to a situation in which every fisher catches as much as possible, all the time. If there is a large population of fisher people, this inevitably leads to overfishing.

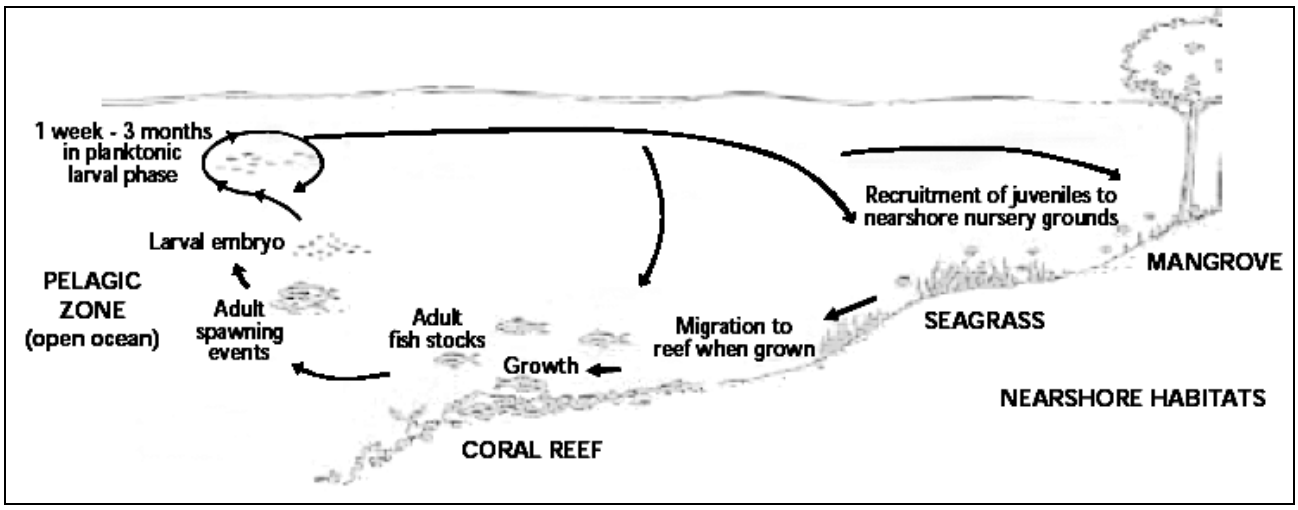
Overfishing is not good for anybody - it's bad for the fish, bad for the environment, and bad for fisher people. When a fish stock is overfished, fisher people have to work harder, with more dangerous and destructive gear, just to catch low numbers of small fish. Ultimately the fishes are nearly extinct, and fisher people can be driven into extreme poverty and hunger.

To avoid this tragedy, the fishing effort must be controlled.

Controlling fishing effort is the immediate goal of most fisheries management. When there is a large population of fisher people, fishing effort must be limited somehow (by government, by the local community, or both working together) to avoid overfishing. Numerous creative examples of controlling fishing effort have been tried throughout Southeast Asia.

Tropical Fish Ecology: Species and Habitats Affect Each Other

The discussions above emphasized just one fish stock at a time. But a fish stock does not exist in isolation. Many species require several different habitats to complete their life cycle:



(PH-6, 2001)

In addition, different fish species affect each other. Ultimately, all species are connected in a large and complex **food web**. "**Primary producers**" - organisms that use sunlight to produce food (such as phytoplankton, mangrove trees, and seagrass) - are eaten by "**consumers**" such as zooplankton, invertebrates, fishes, reptiles, birds and mammals. Consumers prey upon each other, with large predators such as sharks, seabirds, sea lions, and large predatory fishes at the top of the food web. Finally, "**decomposers**" eat any dead or decaying organic material, such as leaves, dead animals, and other detritus, and return the nutrients in that organic material to the food web.

The important point is that different species and habitats all affect each other.

Removal or reduction of one habitat will affect species in other habitats. Removal of one species will affect other species, especially those that eat, or are eaten by, that species. In some cases, this can have enormous effects: heavy fishing of one species can cause population booms or population crashes in many other species.

Fishing Methods & Gears in Southeast Asia

We have reviewed how fish stocks respond to a general "fishing effort". However, fishing effort varies with the type of fishing method and fishing gear. Fishers are creative people and are constantly inventing new methods and gear, but in general, there are major categories which include: hook-and-line fishing, which is (usually) relatively mild in its effects; traps, which are (usually) relatively mild; spear fishing, which targets individual fish of certain species; many varieties of nets, which can have different effects depending on their mesh size, and on how they are moved through the water or over the bottom; collection on foot in intertidal areas; and methods that kill or stun all fishes within a certain area, such as cyanide and blast fishing, which tend to be very destructive.

Destructive fishing methods

All fishing methods will have some effect on the targeted fish stocks, but some also have powerful effects on other species and the surrounding environment. Of particular concern are methods that:

- *destroy habitat,* such as destruction of coral reefs or seafloor vegetation
- catch *non-targeted species*
- catch *young fish* (i.e. small fish) that have not yet had a chance to breed.

This table shows some fishing methods that are particularly destructive (modified from PH-6, 2001):

Blast fishing	Causes *immediate reef destruction*. Destroys the backbones of fish. Kills all living things in the vicinity, including young fish, many other fish species, invertebrates and coral. Reduces tourism. Requires many decades for recovery.
Cyanide fishing (stunning of individual fish for live-fish collection)	Used to stun coral reef fish for live-fish collection, for the food fish or the aquarium fish trade. Unfortunately, also kills coral polyps (the organisms that build coral reefs) and invertebrates. Unsafe for divers. Reduces tourism.
Electrofishing	Indiscriminately kills young fish and non-targeted species.
Fine-mesh nets	Indiscriminately captures small fish; therefore, captures many young fish and many non-targeted species.
Trawl	Scrapes seabed and destroys sea-floor habitat; indiscriminate catching of non-targeted species
Purse seine	Indiscriminate catching of non-targeted species
Drive-in methods (herding fish toward nets)	Pounding destroys corals and reef. Catches many non-targeted species. Overfishes coral reefs. Unsafe for divers.
Spear fishing	Catches rare remaining large fish on reefs and depletes

(with compressor or SCUBA)	certain species. Creates a reef community consisting of small, undesirable fish. Unsafe for divers.

Handout 9.3: Illustration of Some SE Asian Fishing Methods

Example: Coral Reefs and Different Fishing Methods

Some types of habitat are especially vulnerable to certain types of gear. For example, coral reefs are vulnerable to many gear types and fishing methods.

Fishing gear	Species caught	Negative impacts on habitat/species	Selectivity of gear	Efficiency of extraction
Traditional methods				
Hook-and-line	large fish	low	medium	low
	squid	low	high	low
Gill, barrier, trammel, cast nets	variety of fish	low	medium	low
Beach seine	shallow, schooling fish	medium	medium	medium
Small drive-in nets	variety of fish	medium	medium	medium
Hand nets	live fish or aquaria	low	high	low
Hand spears	large demersal fish	low	high	low
Traps	demersal fish, lobsters	medium	medium	low
Fish corrals/fences	shallow schooling fish			
	tidally migrating fish	high	high	low
Gleaning or gathering:				
Walking at low tide	seaweed, invertebrates	high	high	high
Free-diving	invertebrates incl. octopus	low	high	medium
Non-traditional (modified) methods				
Trawls	various fish, invertebrates	high	low	high
Drive-in nets *(muro-ami, hulbot-hulbot)*	wide variety of fish	high	low	high
Explosives	all fish	high	low	high
Poisons*	live food fish and aquarium fish	high	medium	high
Spear-gun using SCUBA	large bottom fish	medium	high	high

*Poisons kill many organisms on the affected area of reef, but only the fish are collected.

(PH-6, 2001)

Additional Fishing Methods Common in Southeast Asia

Live-fish collection

Coral reefs are often targeted for collection of live fish, usually collected by stunning them with cyanide. "Ornamental" fish are sold to aquarium dealers. Some food fish are also collected alive. An estimated 20-24 million fish, 11-12 million pieces of coral, and 9-10 million other invertebrates are collected and traded each year.

Live-fish collection can be intense enough to overfish certain desirable or threatened species. Collection methods can also damage other species and the environment (e.g., cyanide fishing), and are often hazardous for the human divers. However, if safe collection methods are used, if the total fishing effort is regulated, and if threatened species (e.g. giant clams) are protected, live-fish collection can provide an alternative livelihood for local people.

Collection of marine curios

Marine **curios** are attractive marine objects that are sold as souvenirs, or made into handicrafts such as jewelry. Species commonly collected for curios include corals, attractive mollusk shells, sea stars, and pufferfish. People usually collect the curios by walking at low tide, or by snorkeling.

Many curio species are becoming both smaller and rare, a sign that they are being overfished. A curio trade can be an aspect of sustainable tourism, but it must be monitored and managed to ensure that rare species are not overfished.

Discussion— Fishing Methods in MPAs

What fishing methods do you think should be prohibited within MPAs that cover different kinds of habitats? Are any of the above methods currently used in your MPA?

9.2 FISHERIES MANAGEMENT STRATEGIES FOR SE ASIA

We have reviewed some basic principles of fisheries science: the importance of fishing effort, the vulnerability of fisheries to overfishing, the inter-relatedness of different species, and some of the variety of fishing methods and gears used in Southeast Asia. Armed with that knowledge, what exactly can a MPA manager do when it is clear that overfishing is occurring, or that destructive fishing methods and gears are being used? There are a wide variety of potential solutions, many that have been discussed so far in the training. Some strategies will be reviewed here, and application in specific areas will be discussed.

A Review of Practical Management Strategies & Tools *(modified from PH-6, 2001)*

Closed areas - restricting or zoning certain areas to entirely eliminate fishing, or to limit fishing to certain small-scale, nondestructive methods and gear. *Marine Protected Areas usually are or include closed areas.*

Closing areas is an approach that can protect a portion of a fish stock, a particular life stage of the fish stock (such as juveniles or spawning adults), or vulnerable habitat such as coral reefs or seagrass. Closing areas also reduces overall fishing effort throughout a larger area.

Closed seasons - restricting the take of specified fish species to a certain time of year. This reduces overall fishing effort by reducing fishing time. It may also be used to protect certain life stages of a species (e.g. during spawning season), or to allow an overfished stock time to recover.

Licensing, permitting & taxes - Licenses, permits and taxes can be used to limit the number of fisher people in a fishery (by only granting a certain number of licenses or permits). Income from license sales or taxes can also be used to finance the cost of fisheries management or can be spread to the local community.

Allowable catch levels, quotas & size limits - This method puts an upper limit on the overall catch size. Typically, an estimate of the Maximum Sustainable Yield catch is calculated (this requires some good research and information on the fish stock), and the overall catch is then divided into quotas allotted to nations, fleets, fishing companies, or individual fisher people.

Restricting fishing methods - Limiting a fishery to a certain type of fishing gear. This may be done to reduce overall fishing effort (by prohibiting use of methods & gear that are too efficient), or it may also be used to protect certain species or habitats by discontinuing use of destructive gear. Regulations of mesh size or trap opening size can also be used to spare juveniles or certain species.

Handout 9.4: Some Management Strategies for Specific Problems

Handout 9.5: Applying Management Tools

Exercise 9.2 - Applying Management Tools to a Real Problem

With your group, pick one specific conservation issue that members of your group are currently facing in or near a MPA. The issue might relate to overfishing, fishing methods or gears, user conflicts, MPA access, or any other conservation problem.

On the **"Applying Management Tools" handout**, write down a brief description of the problem, and then consider each of the five major categories above. *Have any of these methods been tried? If so, what was the outcome? If not, should they be tried?* Fill out the handout and discuss with your group which method(s) might be best for this problem.

Specific Management Considerations for Different Habitats

Southeast Asian fisheries have some particularly valuable and vulnerable habitats, including estuaries and lagoons, seagrass beds, coral reefs, and mangrove forests. These habitats can each benefit from certain management strategies: *(modified from PH-6, 2001)*

Estuaries & Lagoons

Estuaries and lagoons are shallow, semi-enclosed bodies of water with variable salinity, often with soft-bottom mudflats. They are very productive and support many specialized fisheries, including fishes that breed or nurse in lagoons & mangrove areas; crustaceans and mollusks that live in soft bottoms; and species tolerant of varying salinity, such as milkfish, tilapia, and shrimp. Some guidelines for management include:

- Minimize nearby land uses that cause removal of natural vegetation, landfill, sedimentation, pollution, or that promote urbanization;
- Maintain the natural salinity by not changing the normal fresh and saltwater inputs to the area (e.g., not damming rivers);
- Regulate the type and extent of nearby aquaculture;
- Regulate fishing gear & fishing effort in the area;
- Require an environmental impact assessment for any nearby construction.

Mangrove Forests

Mangrove forests are extremely productive. They were formerly considered as wasteland and were often cleared and converted to other, less productive, uses. However, one hectare of healthy mangrove forest can supply many resources directly (wood, fish, and crustaceans), and it is now known that mangroves *support many food webs that extend out into other habitats*. One hectare of mangrove forest supports about one ton of fish per year. Important fisheries associated with mangrove ecosystems include shrimps that depend on mangroves for nursery and feeding areas; crabs that feed on mangrove detritus; mollusks that filter-feed on mangrove nutrients; and the many fish species that feed on these animals. These fishes in turn provide food for larger fish species in nearby estuaries and in open water. Many reef and coastal fish

species use mangrove forests as nurseries. Finally, mangrove forests that surround aquaculture can *filter many aquaculture wastes*. Management guidelines include:

- All those listed for estuaries & lagoons, above;
- Prevent removal or destruction of mangrove areas and minimize any cutting of mangrove trees, or disturbance of mangrove vegetation;
- Replant mangrove forests, particularly near aquaculture.

Coral Reefs

Coral reefs are extremely efficient at capturing nutrients and sunlight. They produce *the highest fish yields of any habitat in the world*, per unit area. A single Southeast Asian coral reef can produce about 20 t/km^2/year of usable fish. They are also extremely delicate and are *particularly vulnerable to physical damage*, such as from fishing gear, recreational boats, and trawling. They often occur in association with other habitats, particularly seagrass beds and mangrove forests that provide nursery and feeding areas for many reef creatures. Coral reefs support an extraordinary number of economically important species, including over 1,000 species of fishes; giant clams and other bivalves; lobsters, crabs and shrimps; a variety of small organisms including sea cucumbers, sea urchins, sponges, seaweeds and many snail shells; and large animals such as mackerel, sea turtles, manta rays and dugongs that feed over the reefs. Management guidelines include:

- All physically damaging activities should be absolutely minimized. This includes several fishing activities (drive-in nets, trawls, traps, gleaning, etc.), boating and anchoring, recreation and SCUBA diving, dredging, construction, etc.
- Use of any fishing gear that selects young or immature fish should be minimized, since coral reefs are important breeding grounds for many species.
- Coral reef tourism can be encouraged as an alternative means of income, but should be regulated to ensure that reefs are not damaged.

Review: Zonal Management

MPAs are a form of **zonal management**. As discussed on day 2, zonal management involves dividing the marine area into zones of different uses. Zones may be closed entirely to fishing, or may allow certain kinds of use. Zonal management can be particularly effective for protecting certain habitats such as coral reefs, or nursery or breeding areas of certain fish stocks that use multiple areas during their life cycle.

Take a moment to review what you learned earlier about zonal management, and how zones might be used to protect the different habitats discussed above.

Handout 9.6: Suggested Coastal Use Zones

Assessment

We have discussed many possible management strategies and how they might apply to certain tropical marine habitats. Two important questions, however, are:

How do you know if an existing strategy is working?
How do you know when a new strategy is needed?

This is the role of *assessment*- assessing the local situation, the fishing effort, the health of different habitats, the economic status of the fisher people, whether overfishing is occurring, and so on.

Some habitats are obviously in need of protection - a major coral reef that is being damaged by blast fishing, for example. In other cases, fisheries managers will need some information about how much of a certain habitat is being destroyed and how much still remains intact. For effective habitat management, it is also necessary to know the biology and ecology of the major fish stocks, and especially where the spawning or nursery grounds are for different species.

In the case of fishing methods & gear, fisheries managers need to be alert about what new type of gear are being used. Fisher people are creative and are constantly inventing new ways of catching fish, and fisheries managers need to keep informed about new methods.

To assess overfishing, MPA managers need some kind of measure of fish catch, fish size, or fishing effort. Sometimes governments can fund the necessary research. In many Southeast Asian countries, there is not enough funding available to monitor most fisheries. Local fisheries managers sometimes rely on informal interviews with local fisher people and observation of the fishing fleet. An additional very valuable source of information is starting a fish-measuring program. Even occasional measurements of fish size can be very useful in tracking fishing effort and assessing overfishing. This is a good research project for fisher people to be engaged in if financial incentives can be provided. This is also a good introduction for engaging fisher people in MPA management and beginning a process for building trust.

Handout 9.7: Measuring Fish

Discussion - What are the Signs of an Overfished Area?

Discuss with your group all the ways you can think of to recognize when a fish stock is being overfished.

- *What information is necessary in order to know when overfishing is occurring? In your local area, do you have access to this information?*
- *What management action might you take to respond to overfishing*?

(first look at changes in fish populations over time, then look at fisher effort change over time, then look at fishing gear and other practices, then look at other factors like water quality, loss of habitat, look at alternative actions to managing fisheries, then look at alternative livelihoods.)

Handout 9.8: Some Signs of Overfishing

9.3 RESPONSIBLE MARICULTURE PRACTICES

Common Mariculture Practices in Southeast Asia

Aquaculture is the deliberate culture of aquatic plants or animals for commercial purposes. It may use fresh, brackish, or marine water. Aquaculture that uses marine water is referred to as **mariculture**. Species commonly used for mariculture in Southeast Asia include:

- seaweeds
- bath sponges
- crustaceans, such as shrimp, crabs, and lobsters. Shrimp farms are very common.
- bivalves, such as pearl oysters, cockles, and (recently) giant clams.
- fishes, particularly tilapia, and also milkfish, mullet, rabbitfish, and others.

Mariculture can provide important sources of income, and improved nutrition, for local fisher people. However, mariculture can cause problems as well. Mariculture works best when it is located in an appropriate site for the species, does not require significant destruction of native habitat and native fisheries, and is responsibly managed so that it does not harm the surrounding environment by the spread of wastes, pollution, or diseases.

Handout 9.9: Impacts and Benefits of Mariculture Practices

Problems with Mariculture

Though mariculture can provide alternative sources of income, it also can cause significant problems for the surrounding environment, as well as loss of some fisheries income. Mariculture

industries should be monitored whenever possible, and regulated or otherwise encouraged to use environmentally friendly practices. Some common issues are: *(modified from PH-6, 2001)*

Destruction & conversion of natural habitats, with loss of native fisheries - e.g., mangrove forests cleared for shrimp farms. This also can cause loss of productive fishing grounds.
Questions to ask include:

How much natural habitat was cleared to create the mariculture industry?
What fisheries or other sources of income (e.g. tourism) were affected?
How could that habitat have helped support a healthy native fishery?
How can the trade-off of mariculture vs. native fisheries be measured?

Pollution from uneaten feed, wastes (e.g. feces), antibiotics & other chemicals, pond sedimentation, etc. This is a major problem with many forms of mariculture.
Questions to ask include:

How crowded are the cages or pens? Are animals kept at a reasonable density?
How much feed do the animals actually eat? How much is wasted? Are there different feeding schedules or methods that would cause less food waste?
Are antibiotics, pesticides, etc. routinely used, or only when needed?
Are cages frequently abandoned due to sedimentation?

Introduction of exotic species and diseases

Is the species native or non-native? How might it affect the local environment?
Is the species genetically modified?
Is there a program in place to control the introduction of exotic species?
What disease outbreaks might occur, or which have already occurred?

Discussion—Mariculture in MPAs

- *Does mariculture in your area have a substantial impact on any critical habitats?*
- *What mariculture practices would you encourage to lessen impacts on water quality?*
- *If you were going to allow mariculture activities in your MPA, which species are the least damaging to the environment?*

9.4 FIELD TRIP: AQUACULTURE

Activity: Field Site Visit

Visit lobster and finfish aquaculture operations.

Handout 9.10: Mariculture Evaluation Form

Compare and contrast levels of impacts from different mariculture operations that will be visited on the field trip using the handout.

Before setting out on this field trip, think about what you have learned and discussed today about fishing effort, fishing methods, habitats, overfishing, and the benefits and problems of mariculture.

- *What questions do you have about the mariculture methods that you will see?*
- *Are similar methods in use in your area?*
- *What do you think the role of a MPA manager should be in understanding, monitoring, or regulating local mariculture practices?*